

I CLAIM:

1. A method for forming a substantially spherical free air ball on a fine non-oxidizable wire in a computerized
5 bonder having an electronic flame-off (EFO) apparatus operable to generate pulses of different heights and widths, comprising the steps of:

positioning a free end of said wire opposite to an EFO electrode, spaced apart by a gap;

10 applying a train of EFO current pulses between said electrode and said wire;

controlling said pulse heights to melt a pre-determined volume of said wire while minimizing the heat-affected zone of said wire and the wire necking, thereby creating free air balls of small diameters and high ball/wire strength;

controlling said pulse widths to create a substantially spherical ball shape; and automatically calculating the minimum train of

20 consecutive EFO current pulses of various heights and widths, thereby minimizing the time needed for creating one bond and maximizing the number of bonds provided per second.

2. The method according to Claim 1 wherein said train of
25 pulses comprises only two or three pulses.

3. The method according to Claim 1 wherein said wire is selected from a group consisting of gold, copper, silver, alloys thereof, plated materials, and insulated metal wires.

30 4. The method according to Claim 1 wherein said wire is selected from a group consisting of wire diameters in the range from about 15 to 75 μm for gold and about

- 25 to 75 μm for copper.
5. The method according to Claim 1 wherein said wire melting and ball forming is performed in ambient air.
 6. The method according to Claim 1 wherein said train of EFO current pulses is further controlled to reduce size and damage in the heat-affected zone, thereby providing smooth wire loop formation.
 10. The method according to Claim 1 wherein said train of EFO current pulses provides a continuous series of pulses of progressively lower heights, yet various pulse widths.
 15. The method according to Claim 7 wherein said pulse train of progressively lower heights minimizes the heat affected zone of the wire.
 20. The method according to Claim 1 wherein said train of EFO current pulses provides a series of pulses alternating between high and low heights and various widths.
 25. The method according to Claim 9 wherein said low pulse height is configured to prevent overheating of the free air ball and wire necking while maintaining the EFO arc.
 11. The method according to Claim 1 wherein said automatic pulse train calculation is provided by pre-determined empirical data stored in the master file of said computerized bonder.